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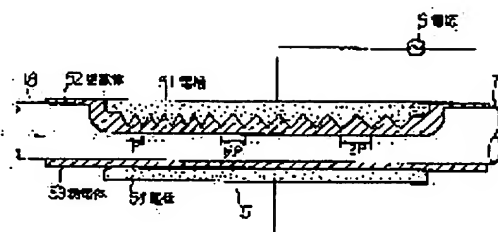
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(54) EXHAUST GAS TREATMENT APPARATUS

(57)Abstract:

PURPOSE: To obtain a large capacity exhaust gas treatment apparatus having a high removing rate and high efficiency.

CONSTITUTION: In an exhaust gas treatment apparatus making nitrogen oxide in exhaust gas harmless using glow discharge plasma, counter plate-shaped electrodes 51, 54 making exhaust gas to be treated pass through, the glow discharge power supply 6 connected to the respective electrodes and the dielectrics 52, 53 covering the inner surfaces of the electrodes are provided. Further, saw-tooth unevenness having pitches increasing along the flow direction of the exhaust gas is formed to the inner surface of at least one of the electrodes.



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CLAIMS

[Claim(s)]

[Claim 1] The offgas-treatment equipment characterized by coming to prepare the serrate irregularity of the pitch which is equipped with a wrap dielectric and increases the power source for glow discharge connected to the tabular electrode which lets target exhaust gas pass, and which counters, and a **** tabular electrode in the offgas-treatment equipment which defangs the nitrogen oxides in exhaust gas using the glow-discharge plasma, and the internal surface of each above-mentioned electrode to at least one internal surface of the above-mentioned electrode in accordance with the above-mentioned exhaust-gas flow.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention is NOX in the exhaust gas discharged from the boiler for power generating plants, a diesel power plant, a gas turbine, various combustion furnaces, etc. And/or, it is related with the offgas treatment equipment by the glow discharge plasma which can carry out mass removal of the N₂ O effectively.

[0002]

[Description of the Prior Art] Drawing 4 thru/or drawing 6 are the explanatory views of the offgas treatment equipment by the glow discharge plasma used from the former. It is NOX in the exhaust gas of a diesel power plant by this equipment. It explains taking the case of the case where it processes.

[0003] In drawing 4, the exhaust gas of a diesel power plant 101 is introduced into the plasma reaction container 105 via the cyclone collector exhaust pipe 104, after removing through and a particle to the cyclone collector 103 through an exhaust pipe 102. the power source 106 which arranges an internal electrode 110 inside the tubed glass reaction container 109, arranges the external electrode 111 outside, and impresses an electrical potential difference to an internal electrode 110 and the external electrode 111 as the plasma reaction container 105 shows a detail to drawing 5 and drawing 6 R> 6 -- **** -- last ** By plasma-izing exhaust gas by the polar zone, it is NOX in exhaust gas. The following principle removes. That is, if a power source 106 is used and an electrical potential difference is impressed between an internal electrode 110 and the external electrode 111, exhaust gas will be plasma-ized by the atmospheric pressure glow discharge phenomenon. And NO₂ The next chemical reaction is caused.

[0004]

$2\text{NO(s)}_2 \rightarrow 2\text{NO} + \text{O}_2 \text{ (1)}$

$2\text{NO} + \text{O}_2 \rightarrow \text{N}_2 + 2\text{O}_2 \text{ (2)}$

In addition, the plasma is NOX which the high energy electron accelerated by external electric field is the ionized gas in which it collided with the gas molecule and an excited molecule, an excited atom, a free radical, ion, a neutral particle, etc. were intermingled, and obtained energy (several eV thru/or several 10eV) by the above (1) and (2) formulas. It is N₂ as a result of having become an activity kind chemically and having caused the complicated reaction. And O₂ It is thought that it becomes.

[0005] now -- if engine exhaust gas is plasma-ized as mentioned above using an atmospheric pressure glow discharge phenomenon -- 50-200 ppm (NO+NO₂) The concentration and 30 thru/or 60 l/min which is extent the power supplied from the plasma generating power 106, i.e., a power source, in the range of the flow rate of extent -- several -- W thru/or several 10 -- the range of W -- NOX An elimination factor can attain 80 thru/or 90%.

[0006] Therefore, it is utilized as exhaust gas antipollution measure equipment of the equipment accompanied by various combustion, such as a boiler, a gas turbine, and a diesel power plant.

[0007]

[Problem(s) to be Solved by the Invention] There were the following troubles with the above-mentioned conventional equipment, and utilization was difficult.

** It is a certain constant rate, for example, 60 l/min, about the amount of emission. If it is made to increase above from extent, the glow discharge plasma stops occurring and it is NOX. And removal of N₂O becomes impossible.

** If magnitude of an electrode is lengthened to an exhaust gas flow direction, it is NOX again. And the N₂ O removal effectiveness falls remarkably.

** Since the reaction container of a cylindrical shape is used, they are several 1,000 - number 100,000 l/min,

for example. When large capacity-ization of a class is considered, parallel connection of many reaction containers will be carried out. In this case, there is increase of the invalid tooth space to which it comes from a cylindrical shape, and a space factor is bad.

** By the reason of the above-mentioned ** - **, it is for example, several 1,000 - 100,000l. of numbers and min. Use as mass offgas treatment equipment of a class cannot be performed.

[0008] For this invention, it was made in view of this present condition, and the NOX concentration in exhaust gas is 50-200 ppm. Extent and N2 O concentration are 50-200 ppm. It is exhaust gas which is extent For example, 1,000 l/min It is NOX even if it processes by the large flow rate of extent. And it aims at offering the offgas treatment equipment by the glow discharge plasma applicable for large capacity with the high elimination factor of N2 O.

[0009]

[Means for Solving the Problem] This invention adopts the following means in order to solve the above-mentioned technical problem.

[0010] That is, in the offgas treatment equipment which defangs the nitrogen oxides in exhaust gas using the glow discharge plasma, the serrate irregularity of the pitch which is equipped with a wrap dielectric and increases the power source for glow discharge connected to the tabular electrode which lets target exhaust gas pass, and which counters, and a **** tabular electrode, and the internal surface of each above-mentioned electrode to at least one internal surface of the above-mentioned electrode in accordance with the above-mentioned exhaust gas flow was prepared.

[0011]

[Function] If it makes inter-electrode generate the glow discharge plasma in the above-mentioned means, it is NOX in exhaust gas. The plasma is activated, and the gas containing N2 O causes the next reaction, and is defanged.

[0012]

$2 \text{ NO} \rightarrow \text{N}_2 + \text{O}_2$ (3)

$2\text{NO(s)}_2 \rightarrow \text{N}_2 + 2\text{O}_2$ (4)

$2\text{N}_2 \text{ O} \rightarrow 2\text{N}_2 + \text{O}_2$ (5)

At this time, since serrate irregularity is prepared in the electrode surface, it is easy to generate glow discharge. Moreover, since it is spreading gradually as spacing of the irregularity of a serrate electrode goes to an outlet side from an exhaust gas entrance side, a plasma current decreases, so that an outlet side is approached. Therefore, the power which contributes to plasma generating on the whole decreases. Moreover, NOX of an inlet port It reaches, N2 O concentration is high, and it is NOX of an outlet. Since it reaches and N2 O concentration becomes low, it is NOX. A part with high concentration has much power, and it is NOX. Power will be supplied to a part with low concentration few. In a downstream, if there is too much impression power that the current density of the plasma tends to increase, generating of the glow discharge plasma will tend [furthermore] to become unstable, but since the electric power supply of a downstream is stopped, plasma generating is stable.

[0013] They are reduction of power consumption, and NOX as mentioned above. Improvement in an elimination factor and stabilization of the plasma are obtained.

[0014] Moreover, since each electrode is covered with the dielectric, the corrosion by gas is prevented and its endurance improves.

[0015]

[Example] Drawing 1 - drawing 3 explain one example of this invention. In addition, the part explained in the conventional example omits explanation, and explains the part about this invention to a subject.

[0016] In drawing 1, 1 is a general-purpose combustion furnace and is an object for taking an exhaust gas antipollution measure. 2 removes the particles contained in exhaust gas in the exhaust pipe which transports the exhaust gas of the combustion furnace 1 of the above-mentioned general purpose to dust separators (cyclone collector etc.) 3, and said dust separator 3. The exhaust pipe with which 4 transports the exhaust gas of a dust separator 3 to the plasma reaction container 5, the power source to which 6 impresses plasma generating power to the electrode of the above-mentioned plasma reaction container 5, and 7 are the exhaust gas output tubes connected to the plasma reaction container 5.

[0017] Drawing 2 explains the plasma reaction container 5 to a detail. The parallel tabular electrodes 51 and 54 counter and are prepared. Serrate irregularity is prepared in the inside of one electrode 51. An exhaust gas entrance side is formed in P for a 1.5P and gas outlet side, and, as for the pitch of this irregularity, a center section is formed in 2P.

[0018] Moreover, electrodes 51 and 54 are formed in the wrap dielectrics 52 and 53. These serve as the

reaction container 5. The external surface of the reaction container 5 is made from dielectrics, such as glass and ceramics.

[0019] Furthermore, a power source 6 is connected with electrodes 51 and 54. NOX generated with the combustion furnace 1 above And the exhaust gas containing N2 O is sent to a dust separator 3 through an exhaust pipe 2. The particles in exhaust gas are removed by the dust separator 3 after that, and it is sent to the plasma reaction container 5 through an exhaust pipe 4 and the exhaust gas inlet pipe 18.

[0020] If power is supplied to a serrate electrode 51 and the serrate plate-like electrode 54 from the power source 6 for plasma generating, the plasma of exhaust gas will occur among dielectrics 52 and 53.

[0021] This plasma is glow discharge plasma, gas molecules, such as NOX in exhaust gas and N2 O, excite and dissociate, it activates chemically, and the reaction of said formula (3) - a formula (5) produces it.

[0022] Therefore, NOX in exhaust gas It reaches and N2 O is N2. And O2 It is become and defanged. As compared with the conventional example (dotted line), a continuous line shows the removal situation of NOX (50-200 ppm) obtained with the equipment of this example to drawing 3 . however, a flow rate -- 1,000 l/min it is . For the upper part of drawing, about the location of the gas flow direction of the electrode of a reaction container, and the relation of impression power, the lower part is homotopic and NOX. It is the graph which shows the relation of the rate of reduction.

[0023] Since spacing of the serration of the serrate electrode 51 is spreading gradually towards the outlet side from the exhaust gas entrance side (upper edge) as shown in drawing, a plasma current decreases, so that an outlet side (down-stream edge) is approached, as shown in drawing. Therefore, the power which contributes to plasma generating decreases, so that it goes to an outlet one by one. Moreover, naturally within the reaction container 5, it is NOX of a reaction container inlet port. It reaches, N2 O concentration is high, and it is NOX of an outlet. And N2 O concentration becomes low.

[0024] Therefore, it is NOX as mentioned above. The part where concentration is high has much power, and it is NOX. It is NOX by supplying power to the part where concentration is low few. The improvement in effective of an elimination factor and reduction of power consumption are obtained. Although generating of the glow discharge plasma becomes unstable and offgas treatment furthermore becomes impossible in a downstream it there is too much impression power that the current density of the plasma tends to increase, this is controlled and stabilization of the plasma is obtained.

[0025] That is, plasma power is reduced in order as are shown in drawing and it becomes a downstream, and it is ** NOX. Since the electric power supply suitable for concentration is made, it is about 100% of NOX. The elimination factor is obtained.

[0026] With conventional equipment, it is NOX. Since excessive power is supplied also near [low] the reaction container outlet of concentration, it is N2. O2 Decomposed NOX It recombines and is NOX. An elimination factor is about 30%.

[0027] Thus, since according to the equipment of this example spacing of the serration of a serrate electrode was made large so that it went to the outlet side, a plasma current decreases, and it is NOX. Recombination is lost. Therefore, if a reaction container is extended, an elimination factor will improve.

[0028] Moreover, they are for example, flow rate 10,000 l/min - number 100,000 l/min by carrying out two or more parallel connection of the reaction container. But it can process. Since the reaction container is parallel plate-like (square tubed) at this time, a reaction container can be accumulated on min and a space factor improves a useless tooth space as compared with the conventional approach (cylinder).

[0029] In addition, by the above, it is NOX. It is NOx although the example of processing of the included exhaust gas was shown. It is applicable also to processing of the exhaust gas which contains N2 O similarly.

[0030]

[Effect of the Invention] High-concentration NOX which is conventionally generated with the impossible combustion furnace with equipment according to the equipment of this invention as explained above And the exhaust gas containing N2 O can be processed so much. Moreover, if it installs in enlargement or a large number juxtaposition, since it can be further increased by capacity, it is NOX in mass exhaust gas. And the value on the industry as an N2 O stripper is remarkably high.

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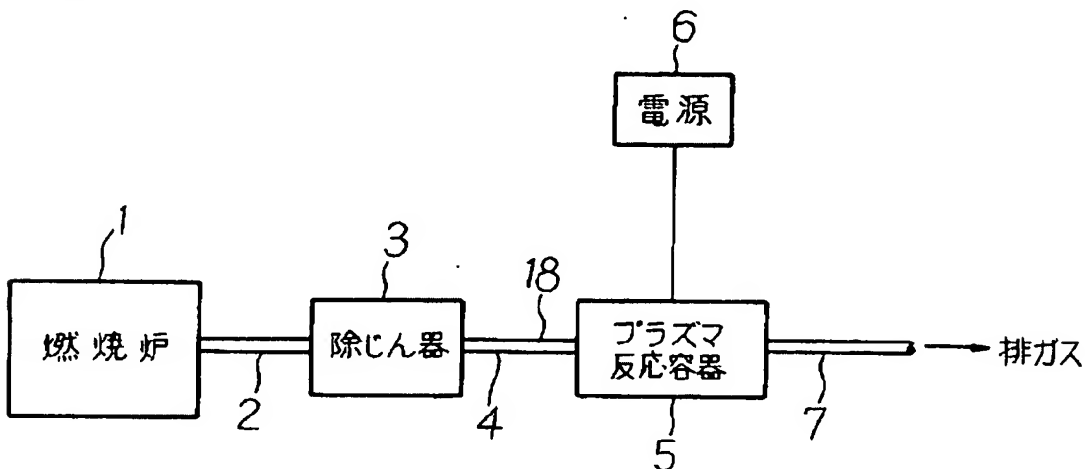
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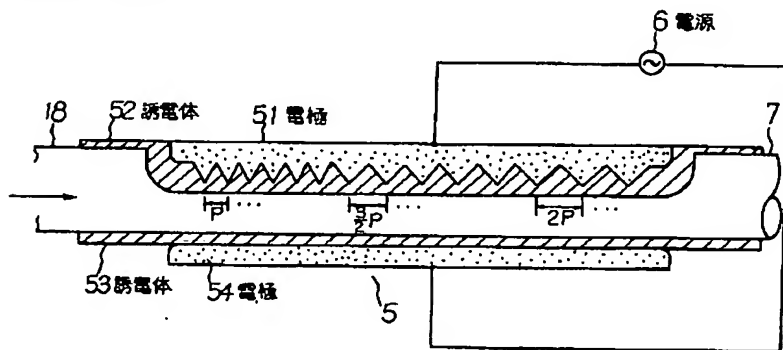
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DRAWINGS

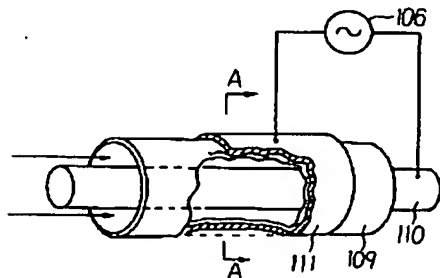
[Drawing 1]



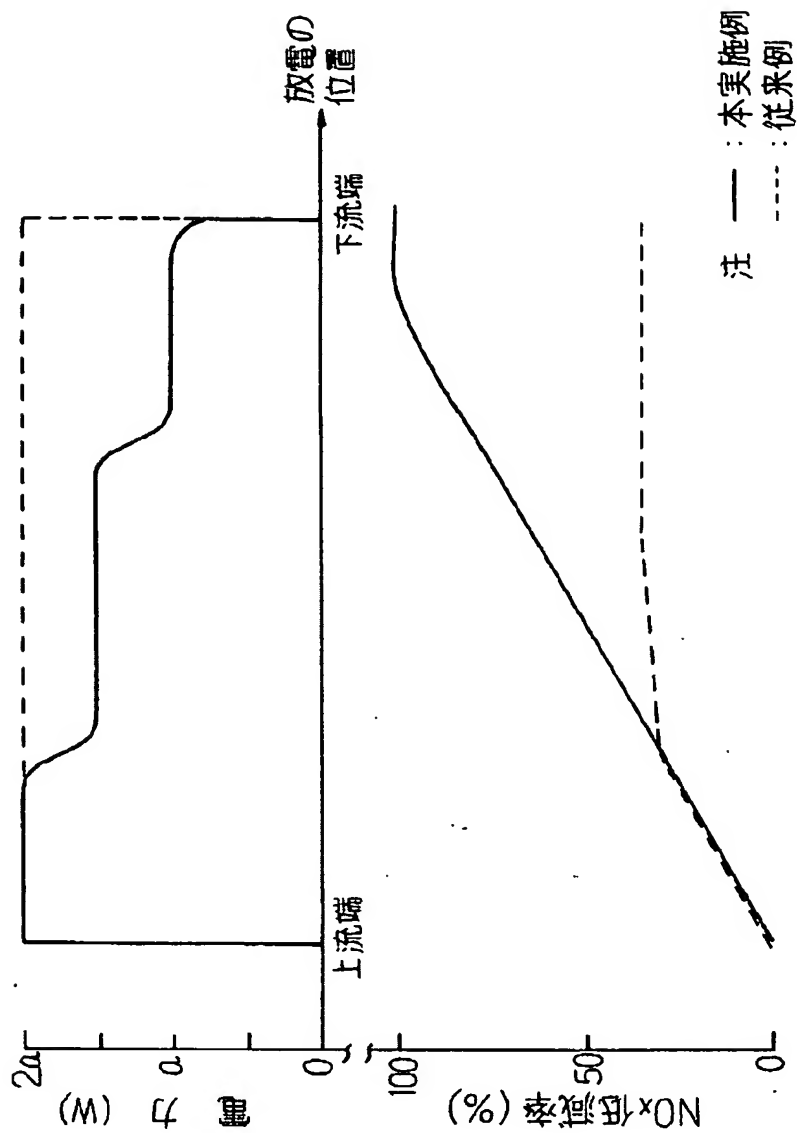
[Drawing 2]



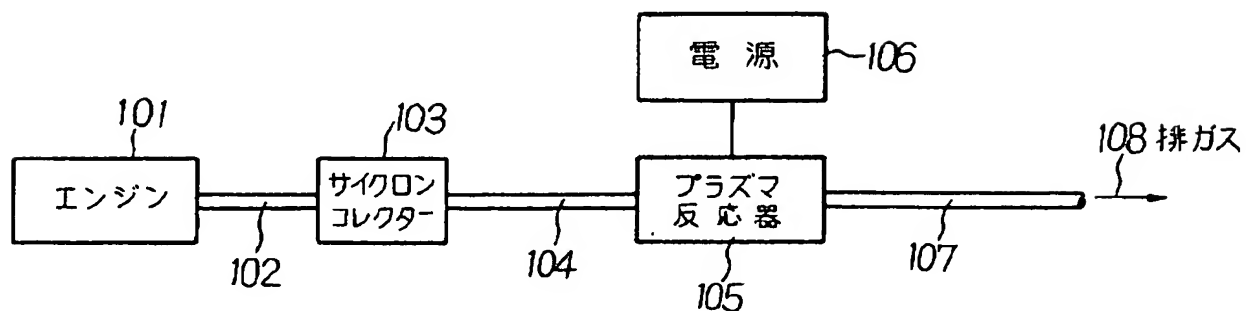
[Drawing 5]



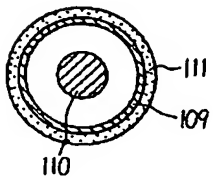
[Drawing 3]



[Drawing 4]



[Drawing 6]



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